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An Exploratory Framework for Assessing Open Source Software Adoption

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ABSTRACT

In this paper we propose that due to the particularities of the Open Source Software (OSS) development process and its perceived "social" connotations, traditional ways of explaining IT adoption are insufficient to understand the case of OSS diffusion. Evidence shows that OSS fails in many cases to displace dominant market leaders even in the case of user's unhappiness with the prevalent solution, while in some others OSS is adopted without a clear advantage. Using a qualitative research approach, we highlight the existence of a new context, in which the adoption of Linux-based OSS platforms by companies is not led only by traditional drivers. User communities and broader social responsibility considerations have been found to exert some degrees of pressure on the IT decision maker. Through the analysis of some significant cases we propose a framework that helps to depict under which conditions significant OSS adoption may unfold.

Key-words: Open Source Software, IT adoption, CIO, IT decision-making, User communities, Social responsibility.

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RÉSUMÉ

Cet article défend que, dus aux spécificités du processus de développement et aux connotations sociales des logiciels libres, les modèles traditionnels permettant d'expliquer l'adoption des TI sont insuffisants pour comprendre la diffusion des logiciels libres. Les faits montrent que dans certains cas, les logiciels libres échouent à remplacer la solution dominante du marché et ceci même dans le cadre de situations où l'utilisateur est insatisfait. Par ailleurs dans d'autres cas, le logiciel libre est adopté alors qu'il ne présente aucun avantage significatif pour l'utilisateur. En nous appuyant sur une recherche qualitative, nous démontrons l'existence d'un contexte nouveau, dans lequel la communauté des utilisateurs ainsi que des considérations de responsabilités sociales peuvent engendrer des pressions sur le décisionnaire SI. Au travers de l'analyse de cas significatifs nous proposons un cadre qui aide à expliquer sous quelles conditions l'adoption de logiciels libres peut être stimulée.

Mots-clés : Logiciels Libres, Adoption de TI, CIO, Décisionnaire SI, Communauté des utilisateurs, Responsabilités sociales.

I. INTRODUCTION

Software adoption has been a field of study by information systems researchers in recent years. Published research models the adoption process as a consequence of a number of factors, both objective and subjective of the decision-maker. These models, although useful in a number of situations, do not fully explain why some systems – in particular those based on Open Source Software (OSS) – fail to make inroads into markets dominated by proprietary systems that do not even enjoy the favor of their user base. Over the past decade, the software market has been steadily concentrating and some systems have acquired an important market share. Examples range from Windows' 90% share of desktop OS to SAP's 58% of the ERP market. Intuition would say that when market concentration is the choice of the customer, rather than due to regulation or to the monopolistic control of a scarce asset, customers would be mainly happy. Nevertheless, an important proportion of customers are unhappy with their IT adoption decisions (Zviran, 2003; Wu *et al.*, 2002).

Coexisting with this unhappiness with dominating systems but nevertheless not adopting an alternative, we have found in our professional practice situations in which OSS was chosen for applications in which it seems that the rational decision would have been a proprietary, proven, solution. The initial motivation of this research, then, was to examine the decisions to adopt or reject OSS, trying to understand if there was any particular characteristic that might be relevant for OSS adoption, beyond those being reported in the traditional IT adoption literature. We suspected that, steaming from the fact that a community of users develops OSS with a sense of "democracy" and without any company dependence, there are two possible factors influencing the decision to adopt OSS not considered in the literature: user driven pressures due to the effect of the developer community and broader considerations of social responsibility. More specifically, we believed that these factors could be (1) the overall "mood" of the OSS movement having a positive potential effect on the adoption decision, giving rise to longer-term views other than technological, and (2) corporate social responsibility aiming at directly maintaining social welfare leaving rents in the hands of customers by decreasing the revenues of private companies.

To clarify these points, we had to gain a deeper understanding of the process by which CIOs decide to adopt or reject OSS. In addition, while the OSS movement as software developer community has received a great deal of attention from the research community, very limited research has looked at the OSS adoption process from a decision maker standpoint. Therefore, we adopted an exploratory research strategy, using a qualitative research methodology, analysing eleven cases using a configurational typology approach.

The main reason for choosing this approach was that, although in the interviews CIOs explicitly tend to state one set of reasons to make a decision, we found that they seem to implicitly operate by another. We addressed and

solved this problem by classifying the companies according the observed output, and then going back to the interviews to understand their underlying reasoning process. This configurational typology allowed us to develop a framework that depicts conditions under which OSS is adopted, showing that a number of circumstances must coexist. These go beyond technical superiority and economic efficiency, as information cascading and user community effects can be significant in some situations.

This paper is organized as follows: after having discussed the literature on diffusion of innovations and IT adoption, we establish a preliminary categorization of IT adoption dimensions. Next, we justify the qualitative research methodology and explain the main traits of the data that we obtained through case studies and CIO interviews. Iterating between the data and the preliminary IT adoption dimensions we use a configurational typology approach to build a framework that explains how OSS[1] adoption decisions are made in the cases that we analysed, showing that traditional criteria are insufficient to explain part of the OSS adoption phenomena. Finally, some conclusions are outlined and further work is proposed.

II. IT ADOPTION AND DIFFUSION

Three main bodies of literature have informed the research on IT adoption: (1) the mechanistic approach, basically analysing rational decision making, (2) research steaming from the more generic technology adoption camps, usually based on diffusion models, and (3) work related to the psychology of the decision maker (see Table 1 for a summarized description of each of the literature streams).

II.1. Rational Decision Making

Current literature considers that the three main underlying concepts for IT adoption in organizations are radicalness of IT innovations, the existence of knowledge barriers and the presence of network externalities. These factors refer to macro-level dimensions and in our understanding are too broad to be useful to understand the CIO decision-making process. Based on the practical experiences of analysts and IT professionals stated in the general press and technical reports (Bozman *et al.*, 2002; Wang and Wang, 2001), we postulate three dimensions at the individual-level that affect the decision process for IT adoption in companies: total cost of ownership, technological attributes, and lock-in.

Cost

Cost is the main factor that has been postulated by OSS followers in front of proprietary solutions. Cost advantage is a good driver to help decision makers to cope with uncertainty and to soften radicalness of OSS adoption, and cost reduction has been proposed

1. Although the paper uses the term OSS, if some confusion arouse in the interviews carried out during the research, we mentioned Linux and Linux-based systems as the types of OSS we were interested in. We specifically did not consider cases of OSS adoption when Linux or other OSS software was an integral part of a closed system, like in the purchase of a router.

Body of Literature	Relevant Dimensions
Rational decision making	
	Cost (hardware, software, reliability, industry maturity, etc)
	Technological attributes (fit to task, difficulty in administration, ease of experimentation, platform long term availability)
	Lock-in (portability, brand image, etc)
Technology diffusion	
	Organizational capabilities (budget size, time availability for experimentation, innovative culture)
	Network externalities (availability of complements, skills of existing IT workers)
Psychology of the decision maker	
	Informational cascading (observation of decisions of peer groups, information overload, existence of conflicting data)
	Reputation concerns of the IT manager (career, incentive incompatibility, agency problems)

Table 1: Main IT adoption decision dimensions.

as one of the main criteria of technology adoption (Bethuyne, 2002). An in-depth analysis of the cost dimension lead us to consider a Total Cost of Ownership (TCO) as the appropriate measure of cost, and conclude that for a company entertaining the overall substitution of a Windows-based end-user solution, the hardware and software cost component accounted between 8 and 15% of the TCO depending on the company IT architecture, while other factors like technical support and downtime ranged between 60% and 65% of the total cost (Armelini *et al.*, 2004). Finally, factors as the irreversibility of the decision and the presence of network externalities by increasing the availability of complements and other ancillaries have a strong influence on technology costs (Shapiro and Varian, 1998).

Technological Attributes

We have grouped under the concept of technological attributes a set of characteristics that are routinely mentioned

by CIOs and by some reports as relevant in the OSS adoption process (Rogers, 1995; Venkatesh *et al.*, 2003). Initially, five criteria have been identified: reliability, performance, scalability, security and brand name. Our starting position is that some of these criteria will be taken into account by CIOs in order to advance in their decision making process and may influence the perceived radicalness of IT innovations. We propose that CIOs use these technological attributes to evaluate radicalness of OSS compared to proprietary solutions and to consider existing knowledge barriers in the adoption of OSS.

Lock-in

Switching costs (Shapiro and Varian, 1998) are present in all technology adopting decisions and organizations tend to minimize the lock-in that these costs generate. Lock-in is produced due to many different decisions, like long term agreements with the suppliers, and the refusal of the workforce to learn new software applications. Lock-in is also caused by external situations that, in most cases, organizations can not control. Switching costs could be formally considered and accounted as an additional cost in OSS adoption, but our belief is that lock-in is treated by the decision maker from a more qualitative perspective.

II.2. Technology Diffusion

Rogers (1995) and Carr (1999) propose a three-pronged classification of approaches to frame this body of literature. These are (1) directional, (2) micro versus macro, and (3) technology versus adopter focused. The directional perspectives analyse diffusion either bottom up, from the grass roots to top management or top-down, where the initiative moves in that direction. The micro level literature analyses decisions at the individual level when the macro is concerned with aggregate patterns of diffusion. Technology adoption can also be viewed as a technical push (deterministic perspective) or adopters pull (process perspective).

In this context, the decision to adopt or not OSS is particularly interesting due to the fact that cost is negligible as no licence fees apply. Also, from a technological perspective, general consensus exists about the superior technological capabilities of OSS. Therefore, to fully understand the OSS adoption problem, one has to study it from a process perspective, influenced by objective and subjective factors that are not directly related to the concrete technology but to the broader organization context in which the IT adoption decision has to be made. In this way, our framework builds up on Rogers (1995) work on the diffusion of innovations and on Fichman's (2004) approach on the IT adoption process. Both of them state that IT innovations create uncertainty in an organization and that organizational factors should be taken into account in the analysis of IT adoption process. In this work, two sets of organizational factors are going to be considered: Organizational capabilities and Network externalities.

Organizational capabilities

In this vein, organizational burdens are relevant and have to be taken into

account in IT adoption decisions. First, knowledge barriers may restrict innovative IT adoption due to learning burden on adopters (Fichman and Kemerer, 1997), "stickiness" of the knowledge involved in the technical problem (Von Hippel, 1994), the sense of irreversibility of the investments on the IT platform (Kogut and Kulatilaka, 2001) and the "risk avoidance" mechanism (Moore and Benbasat, 1991; Venkatesh *et al.*, 2003).

Network externalities

The presence of network externalities also affects the degree of IT adoption in an organization, as the value of using an IT platform grows in proportion to the size of the adopter network (Brynjolfsson and Kemerer, 1997). This phenomenon, which implies increasing returns of scale from the demand side, has two distinctive characteristics, as (a) the ultimate benefits of IT adoption will be determined by the expectation of the decision maker on how the technology will evolve; and (b) increasing returns for the adopter lead to a distinctive pattern of technology diffusion known as market tipping with "winner takes all" outcomes (Shapiro and Varian, 1998). These two characteristics affect the adoption process of a particular technology in an organization, as managers may be tempted to commit to a major initial rollout of a particular technology within a firm, or they may wish to wait in order to minimize the risk of ending up with a "stranded" technology (Markus, 1987; Cool, Diericks and Szulanski, 1997). These issues are particularly relevant to analyse decisions like the adoption of Linux as a platform.

II.3. Psychology of the Decision Maker

A third stream of research that has informed our work analyses the effect of information cascades and herding behaviour in the adoption of IT systems (Li, 2004; Kauffman and Li, 2003). Although the concept of herding has just recently been a subject of interest in the IT adoption literature it has been studied in other areas of management for a much longer time (Graham, 1999).

Informational cascading

Basically, cascading explains the behaviour of decision makers when they are subject to bounded rationality and observe the decisions made by their peers without full knowledge of the reasons why these observed decisions were made. Some researchers have analysed decisions through the prisms of agency theory (Laffont and Martimort, 2002), where CIOs do not decide in the overall best interest of the organization but according a different set of individual objectives. Moreover, the resource-based theory of the firm (Grant, 1991; Wade and Hulland, 2004) establishes how resource performance can drive competitive advantages and how competitors amass resources and capabilities to imitate the strategy of other firms in the same strategic group. Based on this theory, CIOs could follow the decision of a successful rival when they are bounded in their decision making process.

Concerns about the reputation of the IT manager

Of particular interest in platform adoption is what Kauffman and Li (2003) coin as "reputational herding", where CIOs do not want to be associated with having chosen the "loosing platform" and they will go with the majority regardless of evidence that a non conventional decision could be to the best interest of the company.

III. RESEARCH METHODOLOGY

Since one of the motivations for starting this research was our suspicion that the decision to adopt an OSS platform could be influenced by two factors not considered in the literature: the user driven pressures due to the community effect of the developer community and broader considerations of social responsibility, we needed to gather a deeper understanding of the overall decision making process of the CIO. In order to do so, we decided to adopt a research strategy that would allow us to analyse the underlying dimensions of CIO decision-making. For this endeavour, qualitative methods are especially appropriate (Miles and Huberman, 1984), and we decided to carry out 11 case studies of national and multinational companies that have been purposefully. Hence, following Yin's (1994) consideration about how to choose research cases, we sought very diverse companies (from an IS strategy perspective), and ended up with a case selection ranging from multinational and publicly traded corporations to universities, and a public organization created to run a single event that took place during 2004. Table 2 presents an overview of the companies; identities have been disguised for confidentiality reasons.

Following Orlikowski and Baroudi (1991) we approached this research via a series of semi-structured in-depth and open-ended interviews with the respective CIOs. For each interview, we prepared and agreed on a guide based on a previous analysis (Miles and Huberman, 1984; Walsham, 1995) of the IT and innovation adoption literature. In addition to the interviews, we had access to some company information for each of the cases, and carried out follow-up meetings to clarify some unclear issues when needed. All interviews were transcribed and then analysed by each of the three researchers. The results were then compared, and after a constant iteration between the data, the emerging insights of the researchers, and existing literature we finally agreed to use the approach of a configurational typology (Meyer *et al.*, 1993) to structure our findings. Configurations have been widely used in organizational research to understand complex relationships between organizational or environmental variables and performance (Snow *et al.*, 2005). In particular, we followed Ketchen's *et al.* (1997) considerations about configurations in that "the assumption [in these research streams is] that organizational phenomena can best be understood by identifying distinct, internally consistent sets of firms (...) rather than by seeking to uncover one universal set of relationships that hold across all organizations". Hence, in our case, the configurational typolo-

Company	Company Acronym	Industry	Revenues (M€/year)	IS strategy and philosophy
Pharmaceutical	EST	Pharma	475	Support for strategy: Sales Force automation, CRM
Public Organization	FOR	Culture	325 (3 years)	Support for operations: ERP, and visitors control
National Subsidiary Pharma Company	NOV	Pharma	500	Support for strategy: Sales Force automation, research
Savings Bank	ESP	Banking	12,414 (in deposits)	Support for strategy: New Sales channel
Telecommunications	RET	Telco	1,028	Business growth through IS: Internet Data Center
University	UVW	University	68	Support for operations: e-learning and teaching support
Telecommunications	JAZ	Telco	129	Business growth through IS: Internet Data Center
Purchasing Group	EUR	Retail	6	Support for operations: ERP, extranet
Cosmetics	COL	Beauty Care	N/A	Support for operations through an ERP
Telecommunications	TEL	Telco	10,217	Support for strategy and business growth: ERP, CRM, Business Intelligence
Steel Mill	CSA	Steel	2,100	Support for operations: ERP and CRM

Table 2: General information of companies and their overall IT strategy.

gy is used to understand the different behaviours of decision making in OSS adoption. With this instrument we contend, based on Meyer's assertions (Meyer *et al.*, 1993), that a classification of the companies can draw clusters of traits that can order the elements of our population. In this sense, we propose a grouping of our companies that has to be understood as a "mode of scientific explanation" (Meyer *et al.*, 1993). For each of the resulting groups we infer the main driving dimensions of the OSS adoption process, showing how some of the groups do indeed take into account considerations not previously reported in the IT adoption literature.

IV. FINDINGS AND RESULTS

All case studies are major players in their industry and region of activity. As an indication of their position in relation to Open Source, Table 3 presents what could be considered their in-use platform strategies: all companies use Microsoft's Windows on the desktops, and although seven have some OSS in their budgets, only two (FOR and UVW) have a significant amount. Another company, ESP, has only a very limited part of the budget (1%) devoted to OSS, although 25% of its transactions are carried out via an OSS-developed ecommerce portal. The three companies that make a significant use

Company	EST	FOR	NOV	ESP	RET	UVW	JAZ	EUR	CSA	TEL	COL
End-User platform	MsW	MsW	MsW	MsW	MsW	MsW	MsW	MsW	MsW	MsW	MsW
Server platform	IBM	Linux MsW	MsW	UNIX	UNIX	Linux MsW	UNIX	IBM	IBM	IBM-UNIX	IBM
Infrastructure	P	NSwC	PC	ITA	ITA	ITA	NSwC	P	P	ITA	P
% of budget in OSS systems	1,50%	60%	0%	1%(*)	1%	35%	5%	0%	0%	1%	0%
(*) but supports 25% of all business transactions.											

Table 3: IT infrastructure of the case studies[2].

of OSS (FOR, UVW and ESP) used it for systems recently deployed that did not substitute pre-existing systems. All others have large proprietary systems installed or a platform infrastructure that prevents them from easily moving to other architectures.

IV.1. Risk Avoidance

One of the first findings is that all CIOs have high risk aversion, and since most CIOs refer to UNIX, Windows and Linux as specific, distinct environments, adopting Linux is equivalent to a change of platform. Typical phrases mentioned during the interviews that equate Linux to a platform were: "The platform Linux for the desktop has not yet consolidated" or "Windows was not a valid option for the business-to-consumer activity", or "Linux has gained terrain to Unix and has prevented Windows from increasing its share in the server market" and "the Linux platform is a comparable technical platform to Unix". Hence, CIOs consider that the OSS decision has broad implications, as in all cases, they think about Linux as a homogeneous environment where systems and software applications are deployed. In order to maintain equilibrium in their architectural settings and to reduce the technological risks, they avoid introducing platform dispersion or adopting a non-proven solution. EST's CIO explained his vision saying "We want to avoid the risk of having a SIMO[3] in our facilities". All companies except two consider the need to reduce their technological risk as the main criteria for software selection and adoption. Table 4 presents the five main reasons CIOs stated for their decision-making ordered according their relative level of importance, 1 being the most important for the company.

IV.2. Costs

Although cost has been claimed as a breakthrough advantage of OSS in front of proprietary systems, this does not seem evident to decision makers in practice. In fact, the case studies show that cost is the most important factor only for two CIOs (RET and TEL).

2. *Legend*: MsW: Microsoft Windows, P: Proprietary server platform. PC: forced to choose from a product catalogue. ITA: IT Architecture guidelines present. NSwC: No switching costs present due to new deployments.
3. SIMO is the largest IT fair in Spain. One can find there all suppliers of software, hardware and systems that operate in the Spanish market.

Company	EST	FOR	NOV	ESP	RET	UVW	JAZ	EUR	CSA	TEL	COL
Technological risk reduction	1	1	1	1	2	1	1	1	1	2	2
Cost	2	3	2	2	1	2	2	3	2	1	3
Technological aspects	3	2	3	3	3	3	3	2	3	3	2
Supplier brand name	No	No	No	No	No	No	No	No	No	No	Yes
End-user interest	No	Yes	No	No	No	Yes	No	No	No	No	No
(*) but supports 25% of all business transactions.											

Table 4: Decision making criteria for each of the CIOs of the case studies[4].

A typical response was from CSA: "Server operating systems is a very minor percentage of our costs. Even if Linux has a lower TCO, the effect on our overall expense will be negligible." As expected, for some companies, it was not the cost of the new OSS system but the switching costs that was a deterrent; the CIO of EST told us: "Our Information Systems are based on proprietary systems: AS/400, Lotus, Novel, etc. if we chose to migrate to other platforms we would be incurring in additional costs." ESP's CIO mentioned costs as one of the multiple factors that made him decide to implement an OSS solution. "In the cases where OSS has been adopted it was the best alternative. We introduced OSS, leaving choices that were worse or making some platforms more homogeneous. Homogeneity has been important in the migration of UNIX to Linux. The Linux-Intel option was much more economic in terms of expected TCO. Also, Windows was not a valid option because its unreliability."

IV.3. Technological Aspects

Interestingly enough, we found that none of the CIOs considers technological characteristics as the prime decisive factor. Technology, as seen above, was always mentioned together with costs and platform homogeneity.

IV.4. Branding

None of the CIOs formally consider that a significant branding effect exists in vendor selection decisions; "Brand is used if all other criteria have the same level of importance" was the opinion of the JAZ's CIO. And the RET's CIO mentioned "Brand has no weight in decision-making when technological aspects and performance are assured." Nevertheless, some "hidden branding" does exist when the CIO of COL states "We are open to consider OSS if it is backed by IBM and SAP."

IV.5. End-User Interest in OSS

For some CIOs the opinion of the user base is determinant. UVW's CIO said "In our University most research groups use Linux and other OSS systems to develop their projects. There exists an Open Source Committee to promote a university-wide use of OSS. The Committee required us to deploy

4. *Legend*: 1-most important criteria.

OSS in our corporate applications." Likewise, FOR's CIO told us "being a non-for-profit organization that is funded by local and governmental institutions, our sponsors require that our budget be spent minimizing corporate profits whenever possible. All our top managers are very sensible to this, and gave me little option but to deploy an OSS ERP."

V. DISCUSSION: AN EMERGING MODEL

The decision to adopt a Linux-based OSS solution does not seem to be related to the a priori predisposition toward OSS. Two of the adopting companies showed opposed attitudes: "We maintain a philosophy of promoting the OSS," said UVW's CIO. On the other hand ESP's CIO said, "We are not going to promote OSS. We adopted Linux because it was the most appropriate choice in our business-to-consumer retail banking business. I can not foresee any decision considering OSS for other corporate applications." In both cases OSS was adopted. In the first case, the adoption was done under a general framework of OSS adoption. In the second case, OSS was a single decision that was not related to previous or future decisions.

Most CIOs were reluctant to adopt Linux: In EUR they think, "the adoption of Linux represents opening a new line of necessary expertise in the IT department. At the present moment we are not prepared for it. We do not have the necessary experience to do it." The CIO of TEL represents the sceptical view: "We will adopt Linux when it shows to be superior; I believe we will be waiting for a long time." NOV has a different corporate problem "Linux has not been included in our IT corporate catalogue, hence for the time being we are not going to consider it in our IT decision making."

In EST, to include a new technological platform, a pilot test must be done. If the pilot test succeeds they consider adoption. "Organizational decisions can not be based on adventures", explained this CIO.

In contraposition to these, we found other companies that were very genuinely predisposed to adopt Linux. JAZ's CIO, for example, said "We are going to use OSS whenever possible and the ROI is adequate" or RET's "Linux is a suitable option as it meets the architectural constraints and has a great advantage in terms of cost."

As a result of our case studies, we found that adoption of OSS was not led by the predisposition to use. We have found that some companies with a high predisposition to use have low level of OSS usage. RET, for example, has only 600 out of 15,000 desktops using Linux and they don't expect to increase this ratio in the short run. In another predisposed company, JAZ, the CIO stated: "In some recent system developments Linux has not been used since the existing platform of HP-UNIX servers had to be reused."

On the other hand, some companies with a low level of predisposition to use were very active in OSS implementation. In ESP, 25% of business transactions are managed by OSS systems. In another lowly predisposed

company, EST, they decided to develop their web site using OSS because of availability of technical resources and the absence of switching costs.

These findings drove us to consider that decisions to adopt OSS for a specific system were independent of the overall predisposition to use this software.

Hence, using these dimensions we applied a configurational approach (Meyer *et al.*, 1993) to arrange the information about the OSS adoption decision making processes of the case studies. We labelled the overall predisposition to adopt OSS as "perceived openness towards OSS", and refer to the adoption of OSS as "level of usage" and then mapped each of the companies in a 2x2 matrix, shown in Figure 1, in which the companies of a same quadrant show a similar decision making behaviour.

As a result of this configuration approach, we found that the companies could be grouped in four groups:

- *Non-adopters*: These companies affirmed their lack of interest in adopting OSS and do not have any meaningful installation.
- *Specialized*: Two companies have adopted OSS for specialized systems (web server and business-to-consumer system). They are not really open to OSS but superior technology has induced them to adoption.
- *Willing*: Companies in this group are open to use OSS when it becomes a suitable choice for a specific system. All of them were open-minded in using OSS and they were

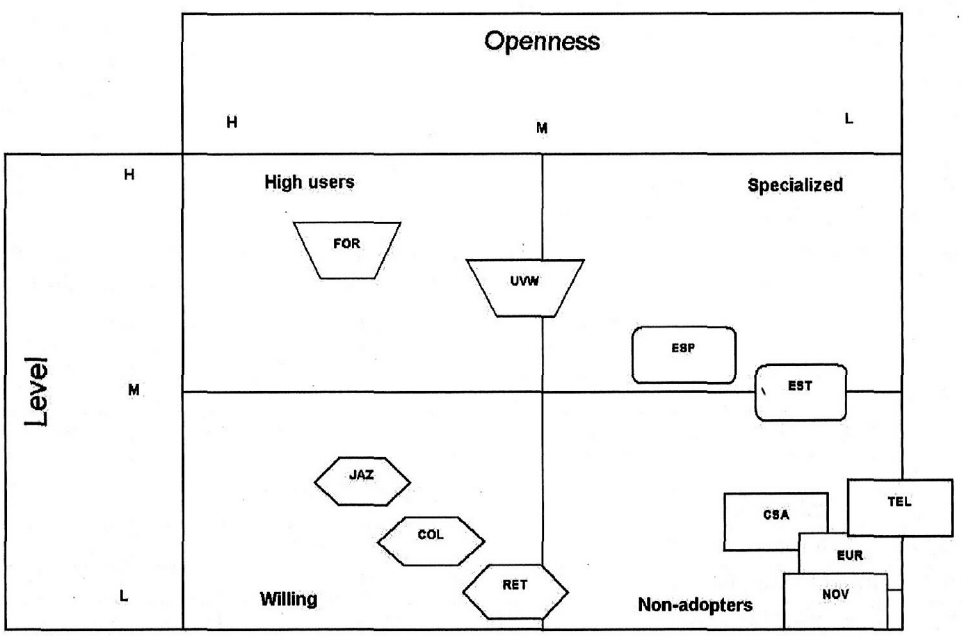

Figure 1: Level of usage and perceived openness towards OSS of each of the companies.

actively seeking opportunities to study the feasibility of OSS choices. None of the companies was planning a full migration of their systems to OSS.

- *High Users*: Two companies are using OSS widely as a platform for their systems. FOR is using OSS for their ERP and UVW is using it for their Intranet and for their e-learning system.

In a second step, we then took these relative positions of each of the companies and went then back to the interview transcripts, in order to analyse them in terms of the IT adoption criteria that we found in the literature. This second step allowed us to identify the attributes or traits that characterize each group. We found that these criteria could satisfactorily explain the behaviour of three of the four groups, but it could not fully explain the case of high users (Table 5 shows a summary of the findings). In these two companies, we found that both CIOs gave significant importance to a dimension that has not been contemplated in previous research on IT adoption: user community power.

Still, the two companies were driven by significantly different motivations. In the case of FOR (company created to organize and run a four month long cultural event), the CIO had to follow a general company consensus, driven in part by the political owners, that the implementation of an OSS initiative was close to the overall company ideology and that it would give the right signal about the organization's intentions to the environment. In this sense, OSS adoption was perceived as being well aligned with the company's overall goal of acting in a socially responsible way, taking into account general welfare considerations. In the case of the university UVW, faculty was the driving force for OSS adoption. They are considered to be heavy users and their interest in the OSS movement for both research and teaching purposes was one part of the final generalized OSS adoption decision. In addition, some sort of "ganging" took place at the user level as other universities in the same region were also deploying OSS.

Regarding the other three groups the analysis of the interviews also showed

	Non-adopters	Specialized	Willing	High Users
Cost			☒	☒
Technological capabilities			☒	☒
Lock-In	☒	☒		
Organizational capabilities		☒	☒	
Network Externalities		☒		
Informational cascading	☒	☒		
Reputation of IT Managers	☒		☒	
User community effects				☒

Table 5: IT adoption dimensions in terms of resulting groups.

to some extent the interplay of the different dimensions within each group:

- Cost considerations influence *Willing* and *High User* groups. JAZ told us that they are committed to adopt OSS in all opportunities they have, but only when ROI analysis is adequate. CSA and RET express their commitment to OSS adoption based on costs studies.
- Technological capabilities are the main reason for companies in *Willing* and *High users* group to expand their OSS usage.
- Lock-in has been voiced as one of the most important negative factor for adopting OSS by *Non-adopters*. Most of them are using proprietary platforms or have been engaged with a supplier for a long time and they are not ready to open a new line of platforms. Companies in the *Specialized* group mentioned lock-in as one of the difficulties in expanding their OSS usage, both for other specialized systems or for the adoption of OSS as a new platform. Old and proprietary systems, IT staff training, and so on introduce many additional costs for companies in this group.
- Organizational capabilities negatively influence adoption of OSS in companies from the *Specialized* group. These companies encounter a lot of organizational constraints in order to widen OSS usage. On the contrary, companies that have decided to promote OSS in their platform adoption decisions use most of the organizational capabilities to increase OSS adoption. They share a culture of innovation and have time and budget available to experiment.
- Network externalities earned in adopting standards platforms have been mentioned by all the companies in the *Specialized* group. In some cases, OSS adoption was the first step to open their platform and to be freed of a proprietary environment.
- Reputation of IT managers in front of making decisions that changes the current infrastructure of the company is the main concern for *Non-adopter* CIOs. They are not ready to assume the cost of a failing adoption.
- Finally, user community effects, as it has been mentioned before, were the main dimension in adopting OSS in the two companies of the *High User* group, superseding any cost or technological fit analysis.

VI. CONTRIBUTIONS, LIMITATIONS, AND FURTHER RESEARCH

The results reported in this research have allowed us to gain a deeper understanding of the CIO decision making process of IT adoption. Although we studied one particular case, OSS adoption, we found some interesting new insights that, albeit supporting most reported evidence of existing literature, will require some careful reconsideration. First, although in the interviews CIOs explicitly tend to state one set of reasons to make a decision, we found that they seem to implicitly operate by another. Two CIOs stated

cost as the main driving factor for software adoption, although they did not adopt Linux after considering it because one had architectural constraints, and the other did not believe the system could sustain the expected growth the company had. Another CIO, after stating that his company decided based solely on cost, explained that he would install a Linux server only if IBM guaranteed its reliability and provided support. Actually, this phenomenon is not new and has been widely studied in the organizational learning field, which differentiated between an individual's "espoused theories" versus the "theories-in-use" (Argyris and Schön, 1978). We addressed and solved this problem by classifying the companies according to the observed output, and then going back to the interviews to understand their underlying reasoning process. Although the observation of this behaviour could be theoretically constraint to our set of case studies, we content that this is a widely extended phenomenon that any IT adoption research should contemplate. Second, the OSS adoption decision making process is a very complex one, and as any IT adoption decision, CIO are guided, in varying extent, simultaneously by all three types of criteria that have been analysed in this work. Thus, rational decision-making criteria, technology diffusion considerations and the psychology of the decision maker appear relevant to any IT adoption decision. More specifically, cost is not enough to understand the IT adoption decision making process and some factors like lock-in, brand, and a tendency to preserve CIO's reputation in the industry can be more determinant.

Third, preliminary evidence has been found that decision makers have latent reasons that explain the majority of the observed behaviour. These reasons drive us to propose that for a new technology to be massively adopted a number of circumstances must coexist, and these go far beyond technical superiority and economic efficiency. Based on this lack of rationality in the IT adoption decision making process, our findings suggest that CIO's tend toward being influenced by information cascading, as their lack of sufficient information is substituted by their peer's decisions.

Fourth, our research informs about a new dimension in IT adoption decision making: user community effects. Different factors can drive this dimension, such as pressure from programming community practices or from end user opinions, social corporate responsibility considerations, or cultural and social welfare criteria. In some sense, "user gangs" are influencing CIOs decisions to adopt OSS at the platform level and we suspect that this effect of the users groups is becoming more prevalent in the future and should be followed closely.

Fifth, this research adds evidence to already existing research on OSS adoption, as we found significant support for most of the current explanations, although we also found that they seem to be of varying significance depending on the concrete context and state of level of adoption of each company. In this sense, we support Dedrick and West's (2003) results of technological,

organizational and environmental driven OSS adoption.

Finally, from a practitioner standpoint, this typology might help CIOs improve their decision making by allowing them to compare the attributes of each type of behaviour with his or her behaviour and see his or her relative position regarding the adoption of OSS. In addition, the consistency of OSS adoption can be analysed in terms of the dimensions considered relevant by each of the groups, and from this, the difficulties that prevent him or her from moving toward another quadrant can be made explicit.

Nevertheless, as most qualitative research, the generalizability of our results is very limited. This is why this research will be followed-up by a quantitative study, in which we will test the insights gained so far. Hence, this piece of research actually constitutes a first step of an overall pluralistic research strategy, as has been suggested by Mingers (2001). This overall research strategy will allow enhancing the generalizability of our results (Lee and Baskerville, 2003). Therefore, further research will be done, following Markus' (1994), Ngwenyama's and Lee's (1997) and Carlson's and Davis' (1998) suggestion of carrying out a survey to confirm our enhanced understanding of the IT adoption phenomenon. In this way, we hope to not only confirm the existence of these dimensions on a broader basis, but also to get more insight about the relative importance and the relationships that underlie the decision making processes of CIOs.

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